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Identification of risk factors for postpartum urinary retention following vaginal deliveries: A retrospective case-control study

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ABSTRACT

Objective: Postpartum urinary retention (PUR) is an uncommon complication of vaginal delivery, defined as a failure to void spontaneously in the six hours following vaginal birth. The objective of this study was to identify risk factors for PUR in order to provide prompt management.

Study Design: A retrospective, comparative, case-control study, including two groups of 96 patients who delivered vaginally, was conducted at the Women and Children's University Hospital in Lyon, France. Patients were selected based on data extraction from the medical records of the obstetrics and gynecology department. The first group included patients with postpartum urinary retention and the second group, without PUR, was selected randomly, respecting 1:1 matching criteria, paired according to the year of delivery and patient's age at delivery.

Results: Logistic regression analysis found that instrumental delivery (OR 13.42, 95%CI [3.34;53.86], p = 0.0002), absence of spontaneous voiding before leaving the delivery room (OR 6.14, 95%CI [2.56;14.73], p < 0.0001), no intact perineum (OR 3.29, 95%CI [1.10;9.90], p = 0.03) and vulvar edema or perineal hematoma (OR 8.05, 95%CI [1.59;40.67], p = 0.01) were independent risk factors associated with PUR.

Conclusion: The present study identified risk factors for PUR that should be taken into consideration as soon as delivery is over in order to implement appropriate management. Future studies are needed to assess the contribution of early systematic bladder scanning in patients with risk factors for early diagnosis of PUR.

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Introduction

Postpartum urinary retention (PUR) is an uncommon complication of vaginal delivery. It is defined as the inability to completely void after giving birth and occurs with an incidence of 0.45% to 0.9% [1]. Yip et al. were the first to make a distinction between overt (symptomatic) and covert (asymptomatic) PUR [2]. They defined overt PUR as failure to spontaneously void within six hours of vaginal delivery or catheter removal post-cesarean section [3,4]. Overt PUR occurs with an incidence of 4.9% [3]. Covert PUR is defined as a post void residual bladder volume (PVRBV) superior to 150 ml, with no symptoms of urinary retention, and presents with an incidence of 9.7% [3,5]. Postpartum urinary retention can lead to urinary incontinence and detrusor atony, urinary tract infections, anuria, hydronephrosis, and even kidney failure [6–8]. Although the pathophysiology of postpartum acute urinary retention is still unclear, many hypotheses and risk factors have been described as involved, including physiological, neurological, and mechanical causes [4,5]. Several risk factors have been suggested, such as preexisting risk factors (history of urinary retention, nulliparity), and additional risk factors related to epidural analgesia, iatrogenic fluid overload, patient BMI, the baby's birth weight, or vaginal delivery (labor duration, instrumental delivery, episiotomy, perineal edema) [9–11]. Screening for PUR does not occur during standard postpartum care. Therefore, early recognition of risk factors is important in order to provide immediate management and prevent potential damage of an enduring retention. The objective of the present study was to identify risk factors for PUR in

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order to be able to provide prompt management avoiding further complications.

Materials and methods

A retrospective, comparative, case-control study, including 2 groups of 96 patients who delivered vaginally between March 2011 and October 2015, was conducted in the obstetrics and gynecology department of the Women and Children's University Hospital (*Hôpital Femme Mère Enfant*) in Lyon, France. This study was approved by the French ethics committee, registered in the clinical trials register (N° **NCT03876756**) and declared to the National Commission on Informatics and Liberty (CNIL, **N° 17-020**). All patients were informed about the use of their medical data for research purposes. Selection criteria for PUR were patients presenting no spontaneous voiding within 6 h after delivery, associated with a PVRBV greater than 400 ml, as previously defined [3,5,13]. The PVRBV was measured using a bladder scanner, operated by competent midwives. According to Peduzzi [12], a minimum of 90 patients were needed to analyze 9 factors in multivariate analysis. Between March 2011 and October 2015, all patients (n = 96) presenting with PUR were selected for analysis based on data extraction from the medical records registry (BO / WEB100 T - *Hospices Civils de Lyon*) of the obstetrics and gynecology department. The control group was selected respecting 1:1 matching criteria, and consists of 96 patients without PUR that were paired according to the year of delivery and patient's age at delivery. Data concerning patient characteristics (maternal age, parity, primiparity, BMI before pregnancy, average weight gain), delivery characteristics (labor duration > 360 min, instrumental delivery, perineal tear), volume of iatrogenic fluid administered during labor, the period between delivery and the first voiding, characteristics of epidural anesthesia (volume of local anesthesia for epidural > 50 ml, dose of local anesthesia for epidural > 50 mg, duration of epidural anesthesia > 500 min) and perineal complications (hemorrhoids, vulvar edema, perineal hematoma) were collected. Medians of the following data were calculated to obtain a threshold value for further multivariate analysis: BMI before pregnancy, baby's birth weight, labor duration, volume of iatrogenic fluid administered during labor, period between delivery and the first voiding, volume of local anesthesia for epidural, dose of local anesthesia for epidural, and duration of epidural anesthesia. Threshold for second-stage duration was determined according to French guidelines [14]. The statistical analysis was performed using SAS software (SAS 9.4, SAS Institute Inc., Cary, NC, USA). After a Shapiro-Wilk's W test for normality of distribution of the data, continuous data were expressed as mean ± standard deviation (SD) for normally distributed data, or median [interquartile range, IQR] for non-normally distributed data. Incidence data were expressed as number (percentage and 95% confidence interval, 95%CI) calculated according to Wald method. Statistical comparison using Fisher's exact test or χ^2 test as appropriate, and Student *t*-test A value of $p < 0.05$ was considered statistically significant. A logistic regression analysis was performed in order to assess the risk factors for PUR, producing odds ratios (OR) with 95%CI. For the construction of the multivariable models, all variables associated ($P < 0.1$) with PUR in univariate analysis and clinically relevant were subjected to a stepwise logistic regression analysis. Potential confounding factors were eliminated if the P value was >0.1, but remained in the model if the P value was <0.05. If p value was >0.05 and <0.1 during stepwise logistic regression analysis, the variable was excluded from the final result but its value was taken into account for the calculation of the logistic regression model. Only categorical variables were taken into account in the multivariate analysis. The goodness-of-fit of the logistic regression for multivariate analysis was assessed using a Hosmer Lemeshow's chi-squared test. The predictive value of the multivariate analysis was assessed using the area under the ROC curve.

Results

Among the two groups of patients included in the study, the mean maternal age was 29.2 ± 4.8 years in the PUR group and 29.4 ± 4.9 years in the control group (p = 0.86). A total of 63 patients (65.6%) from the PUR group and 38 (40%) from the control group were primiparous (p = 0.0004). The mean labor duration was superior to 360 min for 58 patients (61%) in the PUR group vs. 38 patients (40.9%) from the control group (p = 0.006) (Table 2). Among patients with labor exceeding > 360 min, 71 patients (74.0%) were primipare (p < 0.0001). In PUR group, 47 out of the 58 patients (81%) with labor duration > 360 min were primipare (p < 0.0001).

In the PUR group, 13 patients (13.5%) had urological antecedents and 3 (3.3%) had already presented an episode of PUR after vaginal delivery. In the PUR group, 10 (10.4%) patients had undergone previous caesarian section compared to 7 (7.4%) in the control group (p = 0.47). The mean gestational age at birth was 39.2 ± 2.2 weeks in the PUR group and 39 ± 1.7 weeks in the control group (p = 0.64; Table 1). More than half of the patients (58.3%) from the PUR group presented an excessive weight gain versus 44 patients (45.8%) from the control group (p = 0.08). The duration of second stage labor was more than 45 min for 12 patients (12.5%) in the PUR group and 2 patients (2.1%) from the control group (p = 0.006; Table 2).

Instrumental delivery was performed in 36 patients (37.9%) from the PUR group and 5 (5.3%) from the control group (p < 0.0001). For PUR group, instrumental delivery for second stage ≥ 45 min concerned 11 patients out of 12 (91.7%) and 25 patients out of 83 with second stage < 45 min (30.1%) had instrumental delivery for fetal heart anomaly. Only 7 patients (7.3%) from the PUR group had no perineal lesion after delivery compared to 34 patients (35.8%) in the control group (p < 0.0001). The period between delivery and first voiding attempt was superior to 330 min for 50 (52.1%) patients of the PUR group and none in the control group (p = 0.01).

Among the postpartum complications recorded, 23 patients (24%) from the PUR group and 2 patients (2.1%) from the control group presented with vulvar edema (p < 0.0001), and 29 patients (30.2%) from the PUR group and 6 patients (6.4%) from the control group presented with hemorrhoids (p < 0.0001; Table 2).

Fluid administration during labor was higher than 1500 ml in 48 patients (50%) from the PUR group and 33 patients (35.5%) from

Table 1
Patient characteristics.

	PUR n = 96	Control n = 96	p
Maternal age (years)	29.2 ± 4.8	29.4 ± 4.9	0.86
Gravidity	1.7 ± 1.1	2.3 ± 1.3	0.001
Parity	1.5 ± 0.8	2.0 ± 1.2	0.0002
Primipara	63 (65.6%)	38 (40.0%)	0.0004
Gestational age (weeks)	39.2 ± 2.2	39.0 ± 1.7	0.64
BMI before pregnancy	22.9 ± 3.4	24.3 ± 4.6	0.02
Average weight gain (kgs)	13.8 ± 5.1	12.9 ± 6.8	0.27
Previous caesarian section	10 (10.4%)	7 (7.4%)	0.47
Urological history	13 (13.5%)	0 (0%)	0.0002
Antecedents of urinary retention	3 (3.3%)	0 (0%)	0.25
Symphyseal fundal height at 9 months (cm)	32.5 ± 1.9	32.3 ± 1.9	0.38

Data are presented as mean ± standard deviation or number (%).
PUR: postpartum urinary retention.
P < 0.05 was considered statistically significant.

Table 2
Pregnancy, delivery, and post-partum related data.

	PUR n = 96	Control n = 96	p
Pathological pregnancy	25 (27.2%)	29 (30.8%)	0.58
Presentation			
anterior	77 (81.0%)	73 (79.8%)	
posterior	11 (11.6%)	16 (16.8%)	
transverse	7 (7.4%)	3 (3.2%)	
breech	0 (0%)	3 (3.2%)	0.13
Membrane rupture			
spontaneous	44 (45.8%)	45 (47.4%)	
artificial	51 (53.1%)	43 (45.3%)	
premature	1 (1.0%)	7 (7.4%)	0.07
Labor duration > 360 minutes	58 (61.0%)	38 (40.9%)	0.006
Second stage ≥ 45 minutes	12 (12.5%)	2 (2.1%)	0.006
Instrumental delivery	36 (37.9%)	5 (5.3%)	< 0.0001
forceps	22 (23.2%)	2 (2.1%)	
spatulas	0 (0%)	1 (1.0%)	
Kiwi ventouse	14 (14.7%)	2 (2.1%)	
Intact perineum	7 (7.3%)	34 (35.8%)	< 0.0001
episiotomy	53 (55.2%)	22 (23.2%)	
first-degree tear	24 (25.0%)	31 (32.6%)	
second-degree tear	9 (9.4%)	7 (7.4%)	
third-degree tear 3B	2 (2.1%)	1 (1.0%)	
third-degree tear 3C	1 (1.0%)	0 (0%)	
Manual revision of the uterine cavity	28 (29.2%)	13 (13.7%)	0.009
Birth weight of the baby (grams)	3312 ± 567	3330 ± 522	0.82
Baby's head circumference (cm)	34.8 ± 2.2	34.5 ± 1.4	0.20
Period between the delivery and first voiding attempt >330 minutes	50 (52.1%)	0 (0.0%)	0.01
Pain at day 1	47 (49.0%)	5 (5.3%)	< 0.0001
Hemorrhoids	29 (30.2%)	6 (6.4%)	< 0.0001
Vulvar edema	23 (24.0%)	2 (2.1%)	< 0.0001
Perineal hematoma	10 (10.4%)	1 (1.0%)	0.005
Early mobilization	88 (91.7%)	92 (96.8%)	0.12
Duration of hospital stay (days)	5.4 ± 2.2	3.6 ± 1.2	< 0.0001

Data are presented as mean ± standard deviation or number (%).
PUR: postpartum urinary retention.
P < 0.05 was considered statistically significant.

the control group (p = 0.04; Table 3). More than one bladder catheterization was performed in the postpartum period for 21.9% of patients in the PUR group and 5.3% in the control group (p = 0.0008). Spontaneous voiding before leaving the delivery room occurred for 33 patients (34.4%) in the PUR group and 64 patients (67.4%) in the control group (p < 0.0001), while 41 patients (43.2%) from the PUR group and 94 patients (99%) from the control group had spontaneous voiding after leaving the delivery room (p < 0.0001; Table 3).

The majority of patients had an epidural anesthesia. The duration of epidural anesthesia was greater than 500 min in 51 patients (64.6%) from the PUR group vs. 30 patients (42.1%) from the control group (p = 0.001; Table 4). Bladder catheterization for PUR management was found to have a mean delay of 10.5 ± 10.0 h and a mean total duration of 4 ± 4.8 days. The patients had a physiologic micturition within 3.1 ± 1.8 h after removal of the bladder catheter, with a mean PVRBV of 205.1 ± 285.2 ml (Table 5).

Variables included in the multivariate analysis were: primiparity, absence of spontaneous voiding before leaving the delivery room, second stage ≥ 45 min, labor duration > 360 min, instrumental delivery, no intact perineum, iatrogenic fluid during labor > 1500 ml, vulvar edema or perineal hematoma, and epidural anesthesia (Table 7). According to the logistic regression analysis performed, the factors related with the occurrence of PUR were instrumental delivery (OR 13.42, 95 %CI [3.34;53.86], p = 0.0002), absence of spontaneous voiding before leaving the delivery room (OR 6.14, 95%CI [2.56;14.73], p < 0.0001), no intact perineum (OR

Table 3
Iatrogenic fluid administration during labor and bladder catheterization.

	PUR n = 96	Control n = 96	p
Iatrogenic fluid during labor > 1500 ml	48 (50.0%)	33 (35.5%)	0.04
Bladder catheterization during labor	70 (74.5%)	75 (79.0%)	0.47
Post-partum bladder catheterization	61 (63.5%)	49 (51.6%)	0.09
Post-partum bladder catheterization >1	21 (21.9%)	5 (5.3%)	0.0008
Spontaneous voiding before leaving the delivery room	33 (34.4%)	64 (67.4%)	< 0.0001
Spontaneous voiding after leaving the delivery room	41 (43.2%)	94 (99.0%)	< 0.0001

Data are presented as mean ± standard deviation or number (%).
PUR: postpartum urinary retention.
P < 0.05 was considered statistically significant.

Table 4
Characteristics of epidural anesthesia.

	PUR n = 96	Control n = 96	p
Epidural anesthesia	83 (91.2%)	85 (98.8%)	0.03
Test dose	83 (97.6%)	84 (98.8%)	1.00
PCEA	78 (92.9%)	73 (85.9%)	0.14
Local anesthetic for epidural anesthesia			
Ropivacaine	66 (78.6%)	63 (74.1%)	
Levobupivacaine	18 (21.4%)	22 (25.9%)	0.49
Sulfentanil	80 (95.2%)	78 (91.8%)	0.36
Clonidine	16 (19.0%)	22 (25.9%)	0.29
Complementary bolus of local anesthesia	30 (35.7%)	14 (16.5%)	0.004
Epidural anesthesia extension	33 (37.5%)	18 (21.2%)	0.02
Local anesthesia for extension	33 (94.3%)	18 (100%)	0.54
Sulfentanil for extension	2 (6.2%)	0 (0%)	0.54
Reason for extension			
forceps	18 (48.6%)	3 (17.6%)	
perineal tear suture	3 (8.1%)	1 (5.9%)	
manual removal of the placenta	9 (24.3%)	10 (58.8%)	
other	7 (18.9%)	3 (17.6%)	0.07
Morphine	7 (8.0%)	0 (0%)	0.01
Spinal anesthesia	7 (7.7%)	2 (2.3%)	0.17
Morphine PCA	2 (2.2%)	0 (0%)	0.50
Volume of local anesthesia for epidural > 50 ml	47 (55.9%)	35 (41.2%)	0.05
Dose of local anesthesia for epidural > 50 mg	52 (61.2%)	32 (37.6%)	0.002
Duration of epidural anesthesia > 500 minutes	51 (64.6%)	30 (39.5%)	0.001

Data are presented as mean ± standard deviation or number (%).
PUR: postpartum urinary retention.
PCEA: Patient controlled epidural analgesia.

Table 5
PUR management data.

Delay of bladder catheterization (hours)	10.5 ± 10.0
Duration of bladder catheterization (days)	4.0 ± 4.8
Number of bladder catheterizations	1.2 ± 0.6
Diagnostic post void bladder residual volume (ml)	757.6 ± 373.2
Post void residual volume after bladder catheterization (ml)	205.1 ± 285.2
First micturition after the removal of the bladder catheter (hours)	3.1 ± 1.8
Patients discharged with a bladder catheter	10 (10.5%)

Data are presented as mean ± standard deviation or number (%).
PUR: postpartum urinary retention.
P < 0.05 was considered statistically significant.

Table 6
Risk factors associated to PUR.

	OR [95 %CI]	p
Instrumental delivery	13.42 [3.34;53.86]	0.0002
Absence of spontaneous voiding before leaving the delivery room	6.14 [2.56;14.73]	< 0.0001
No intact perineum	3.29 [1.10;9.90]	0.03
Vulvar edema or perineal hematoma	8.05 [1.59;40.67]	0.01

OR: odds ratio.
CI: confidence interval.

3.29, 95%CI [1.10;9.90], p = 0.03), and vulvar edema or perineal hematoma (OR 8.05, 95%CI [1.59;40.67], p = 0.01; Table 6).

The area under the ROC curve was 0.87 (95%CI: 0.82 – 0.93) indicating a high predictive value of the multivariate analysis. In the same way, the non-significant p value (p = 0.57) of the Hosmer Lemeshow's chi-squared test reflects that the model is correctly specified.

Table 7
Logistic regression results.

	OR [95 % CI]	**p**
Primiparity	1.24 [0.46;3.29]	0.67
Absence of spontaneous voiding before leaving the delivery room	6.01 [2.44;14.81]	<0.0001
Second stage ≥ 45 minutes	0.61 [0.04;9.35]	0.72
Labor duration > 360 minutes	1.46 [0.58;3.69]	0.42
Instrumental delivery	13.50 [2.59;70.22]	0.002
No intact perineum	2.44 [0.72;8.22]	0.15
Iatrogenic fluid during labor > 1500 ml	1.69 [0.70;4.07]	0.24
Vulvar edema or perineal hematoma	8.49 [1.69;42.57]	0.009
Epidural anesthesia	<0.001[<0.001;>999.999]	0.99

OR: odds ratio.
CI: confidence interval.

Comment

During labor and in the postpartum period, the bladder is usually at risk for possible injuries and dysfunction creating the need for identifying specific risk factors for PUR. The present study showed that, following vaginal delivery, an increased risk of PUR was associated to instrumental delivery, the absence of spontaneous voiding before leaving the delivery room, the presence of vulvar edema, and a dose of local anesthetic superior to 50 mg.

Only vaginal operative delivery, which has been described as an important risk factor for PUR [15–18], was considered in the present study. Of note, the proportion of PUR patients undergoing an instrumental delivery was largely superior to that of the overall proportion observed in the department (13%). Hence, the use of instruments during vaginal delivery was found, herein, as an important risk factor for PUR, confirming previous results [15,16,19]. Moreover, perineal hematoma and edema represent classical risk factors for PUR by local compression mechanisms [20]. The results herein corroborate this statement since vulvar edema was found to be an independent risk factor for PUR.

Primiparity is one of the essential risk factors, directly related to the apparition of PUR [10,15,16]. It is very difficult to consider primiparity as an independent risk factor, since it is associated with the prolonged pressure exercised by the fetal head on the maternal soft tissues, which can result into soft tissue edema, stretching neuropathy, and trauma on the pelvic floor muscles [2,19]. In a study by Yip et al. conducted on 691 women who delivered vaginally, it was found that duration of labor over 800 min was significantly correlated with an increased risk of PUR [3]. In the present study, the mean duration of labor in the PUR group was higher than that of the control group and it was nearly half of that presented by Yip et al. However, labor duration did not appear as a significant risk factor during multivariate analysis.

Epidural analgesia is also considered a risk factor for PUR as it directly affects the sensitivity and contractility of the bladder [11,21]. Importantly, it has been noticed that the type of analgesic product used (Morphine, Lidocaine, Catapresan) as well as the dose, plays an important role during post-partum voiding. Herein, it was observed that a high dose of local anesthesia (>50 mg) increases the risk of PUR. Uro-dynamic tests revealed that the epidural analgesia inhibits bladder activity, by inhibition of the afferent Delta pathways [4,22]. Several authors have proposed a systematic indwelling catheterization for all patients undergoing epidural anesthesia during labor, in order to avoid the risks of a distended bladder [22]. This can be discussed taking into consideration the augmented risk of urinary

infections associated with such an intervention [23]. However, if such an intervention is envisioned, it is important to note that recent studies showed that the earlier the bladder catheter is removed, the less frequent PUR is [23].

Iatrogenic fluid overload during labor can lead to bladder overdistention and acute urinary retention [20]. Although it did not appear as a risk factor for PUR in the present study, it may be necessary, for future practice, to establish a limit for iatrogenic fluid administration, a timetable for the intermittent bladder catheterizations, or guidelines for catheterization according to the intravenous fluid intake.

The pain related with the repair of the episiotomy and perineal lacerations or with the presence of hemorrhoids may result in reflex urethral spasm and subsequent PUR [5]. In the present study nearly half of patients complained of pain the second day after delivery, hemorrhoids being the main cause for discomfort. In this context caution must be taken concerning the use of morphine-based drugs, taking into consideration their inhibitory action on bladder innervation. Nonsteroidal anti-inflammatory drugs should be considered at first intention.

The study has some limitations. The sample size and the case-control design may be associated with possible imprecision with potential selection bias due to retrospective data collection despite the use of medical electronic records. Also, this study was performed in a single center and reflects local patterns related to the experience of the medical team, hence minimizing the generalization of the present results. However, the study design was particularly appropriate for the assessment of the risk factors of postpartum urinary retention, a somewhat uncommon complication related to vaginal delivery.

Current guidelines do not recommend routine bladder scanning for the diagnosis of PUR due to the inaccuracy of ultrasound examination measurements which are operator-dependent, and due to the form of the bladder and size of the uterus during postpartum [19,24]. Following the results of the present study, a change of practice is currently being implemented in the department. The obstetrical team has been sensitized to detect these risk factors in order to adapt management and an increase in the use of bladder scanning before leaving the delivery room has been observed. Setting up specific guidelines in each maternity represents an important goal that would allow standardization of current practices and a decrease in delay for diagnosis.

Conclusion

The present study identified risk factors for PUR that should be taken into consideration as soon as delivery is over in order to implement appropriate management. Future studies are needed to assess the contribution of early systematic bladder scanning in patients with risk factors for early diagnosis of PUR.

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Author's contribution

Gery Lamblin: Project development, Manuscript writing, Editing
Gautier Chene: Project development, Manuscript writing
Camille Aeberli: Data collection, Manuscript writing
Roxana Soare: Data collection, Manuscript writing
Stéphanie Moret: Management Data analysis
Lionel Bouvet: Methodologist analysis, Manuscript writing
Muriel Doret-Dion: Project development, Manuscript writing, Supervisor

Declaration of Competing Interest

None.

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